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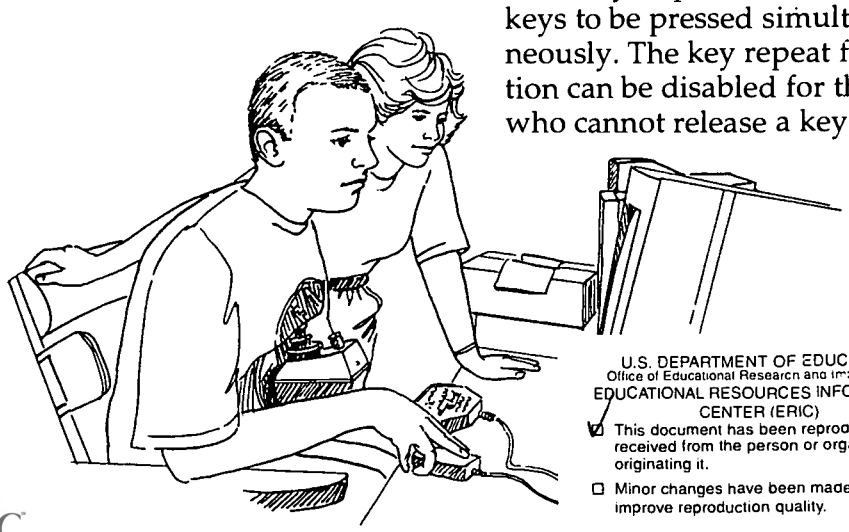
ABSTRACT

This brochure describes the different types of barriers individuals with mobility impairments, blindness, low vision, hearing impairments, and specific learning disabilities face in providing computer input, interpreting output, and reading documentation. The adaptive hardware and software that has been developed to provide functional alternatives to standard operations are described. For individuals with mobility impairments, adaptive hardware and software include changing the positioning of equipment, left- and right-handed keyboards, expanded keyboards, mini-keyboards, keyboard emulation, and voice input. For individuals with blindness, Braille input devices are available as well as voice output, refreshable Braille displays, and scanners with optical character recognition. Individuals with low vision can use large print keytop labels, equipment that modifies display or printer output, and optical character recognition scanners. Advanced speech synthesizers can help those with hearing and/or speech impairments. Individuals with specific learning disabilities can use educational software that provides multi-sensory experiences, interaction, positive reinforcement, individualized instruction, and repetition for skill building. The word processing capabilities of the computer can also help students with dysgraphia. Resources for finding more information about adaptive technology and the DO-IT (Disabilities Opportunities Internetworking Technology) program are listed. (CR)

DO-IT

Adaptive Technology that Provides Access to Computers

People with disabilities meet barriers of all types. However, computers are helping to lower many of these barriers. As word processors have replaced typewriters, electronic spreadsheets have replaced handwritten books, and on-line services have supplemented telephone and written communication, disabled students and employees who have computer access have become capable of handling a wider range of activities independently. Although people with disabilities face a variety of barriers to providing computer input, interpreting output, and reading documentation, adaptive hardware and software have been developed to provide functional alternatives to standard operations.



Mobility Impairments

Input

Equipment which provides flexibility in the positioning of monitors, keyboards, documentation, and table tops is useful for many individuals with disabilities. Plugging all computer components into power outlet strips with accessible on/off switches makes it possible for some individuals to turn equipment on and off independently.

Some adaptive hardware and software assist individuals with little or no use of their hands in using a standard keyboard. Individuals who have use of one finger, a mouth- or head-stick, or some other pointing device, can control the computer by pressing keys with the pointing device. Software utilities can create "sticky keys" that electronically latch the SHIFT, CONTROL, and other keys to allow sequential keystrokes to input commands that normally require two or more keys to be pressed simultaneously. The key repeat function can be disabled for those who cannot release a key quickly enough to avoid multiple selections. Keyboard guards (solid templates with holes over each key to assist precise selection) can be used by those with limited fine motor control.

Sometimes repositioning the keyboard and monitor can enhance accessibility. For example, mounting keyboards perpendicular to tables or wheelchair trays and at head-height can assist individuals with limited mobility who use pointing devices to press keys. Other simple hardware modifications can assist individuals with mobility impairments. For example, disk guides can assist with inserting and removing diskettes; a dedicated hard disk and/or computer network access can eliminate or reduce the necessity to do so.

For individuals who need to operate the computer with one hand, left- and right-handed keyboards are available. They provide more efficient key arrangements than standard keyboards designed for two-handed users.

Some hardware modifications completely replace the keyboard and/or mouse for individuals who cannot operate these standard devices. Expanded keyboards (larger keys, spaced far apart) can replace standard keyboards for those with limited fine motor control. Mini-keyboards provide access to

those who have fine motor control but lack a range of motion great enough to use a standard keyboard. Track balls and specialized input devices can replace mice.

For those with more severe mobility impairments keyboard emulation is available, including scanning and Morse code input. In each case, special switches make use of at least one muscle over which the individual has voluntary control (e.g., head, finger, knee, mouth). In scanning input, lights or cursors scan letters and symbols displayed on computer screens or external devices. To make selections, individuals use switches activated by movement of the head, finger, foot, breath, etc. Hundreds of switches tailor input devices to individual needs. In Morse code input, users input Morse code by activating switches (e.g., a sip-and-puff switch registers dot with a sip and dash with a puff). Special adaptive hardware and software translate Morse code into a form that computers understand so that standard software can be used.

Voice input provides another option for individuals with disabilities. Speech recognition systems allow users to control computers by speaking words and letters. A particular system is "trained" to recognize specific voices.

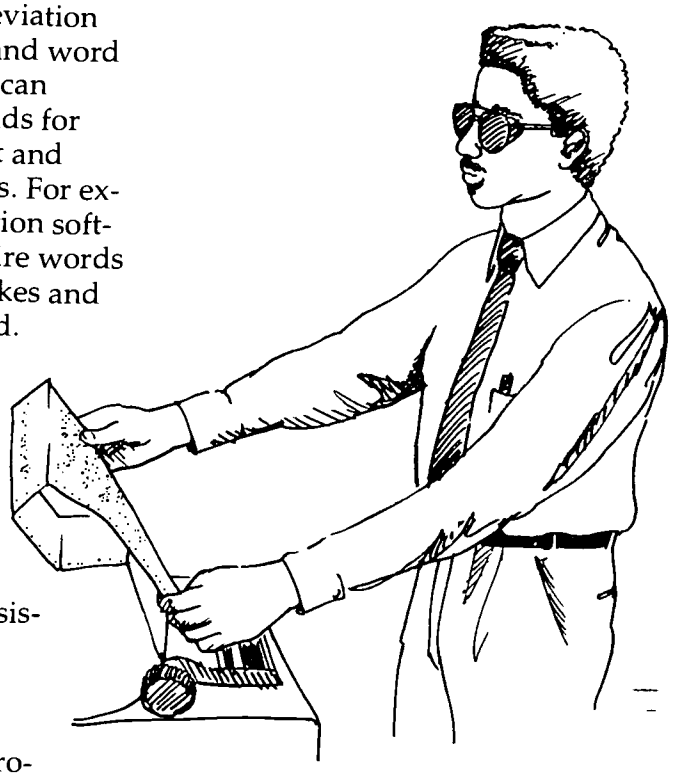
Special software can further aid those with mobility impairments. Abbreviation expansion (macro) and word prediction software can reduce input demands for commonly-used text and keyboard commands. For example, word prediction software anticipates entire words after several keystrokes and increases input speed.

Output

Individuals with mobility impairments who have difficulty obtaining output from printers may need assistance from others.

Documentation

On-screen help can provide efficient access to user guides for individuals who are unable to turn pages in books.



Blindness

Input

Most individuals who are blind use standard keyboards, however Braille input devices are available. Braille key labels assist with keyboard use.

Output

Voice output can be used to read screen text to blind computer users. Special software programs "read" computer screens and speech synthesizers "speak" the text. The availability of earphones for individuals using voice output systems can reduce the distractions for others nearby.

Refreshable Braille displays allow line-by-line translation of the screen into Braille on a display area where vertical pins move into Braille configurations as screen text is scanned. Braille displays can be read quickly by those with advanced Braille skills, are good for detailed editing (e.g., programming and final editing of papers), and do not disrupt others in work areas because they are quiet. Braille printers provide output for blind users.

Documentation

Scanners with optical character recognition can read printed material and store it electronically on computers, where it can be read using voice synthesis or printed using Braille translation software and Braille printers. Such systems provide independent access to journals, syllabi, and homework assignments for blind students. Some hardware and software vendors also provide Braille or ASCII versions of their documentation to support blind users.

Low Vision

Input

Most individuals who have visual impairments can use standard keyboards, but large print keytop labels are sometimes useful.

Output

Special equipment for individuals who are visually impaired can modify display or printer output. Computer-generated symbols, both text and graphics, can be enlarged on the monitor or printer, thereby allowing individuals with low vision to use standard word processing, spreadsheet, electronic mail, and other software applications. For individuals with some visual impairments, the ability to adjust the color of the monitor or change the foreground and background colors is also of value. For example, special software can reverse the screen from black on white to white on black for people who are light sensitive. Anti-glare screens can make screens easier to read. Voice output systems are also used by people with low vision.

Documentation

Scanners with optical character recognition can read printed material and store it electronically on computers, where it can be read using voice synthesis or printed in large print. Some hardware and software vendors also provide large print or ASCII versions of their documentation.

Hearing and/or Speech Impairments

Speech and hearing disorders alone do not generally interfere with computer use. However, advanced speech synthesizers are close enough to human quality to act as substitute voices and thus provide a compensatory tool for students who cannot communicate verbally. Students with portable systems can participate in class discussions once adapted computers provide them with intelligible speaking voices. Word processing and educational software may also help hearing impaired students develop writing skills.

Input

Students with hearing disabilities generally do not have special problems inputting information with a standard keyboard and mouse.

Output

Alternatives to audio output can assist the hearing-impaired computer user. For example, if the sound volume is turned to zero, a Macintosh computer will flash the menu bar when audio output is normally used.

Documentation

Individuals with hearing impairments typically do not have difficulty using standard written or on-screen documentation.

Specific Learning Disabilities

Educational software where the computer provides multisensory experiences, interaction, positive reinforcement, individualized instruction, and repetition can be useful in skill building. Some students with learning disabilities who have difficulty processing written information, can also benefit from

completing writing assignments, tutorial lessons, and drill-and-practice work with the aid of computers. For example, a standard word processor can be a valuable tool for individuals with dysgraphia, an inability to produce handwriting reliably.

Input

Quiet work areas and ear protectors may make computer input easier for individuals with learning disabilities who are hyper-sensitive to background noise.

Software that aids in efficient and accurate input can also assist. Some people can compensate for high rates of input errors by using spell checkers, thesauruses, and grammar checkers. In addition, word prediction programs (software that predicts whole words from fragments) have been used successfully by students with learning disabilities. Similarly, macro software which expands abbreviations can reduce the necessity to memorize keyboard commands and can ease the entry of commonly-used text.

Output

Some learning disabled individuals find adaptive devices designed for those with visual impairments useful. In particular, large print displays, alternative colors on the computer screen, and voice output can compensate for some reading problems. People who have difficulty interpreting visual material can improve comprehension and the ability to identify and correct errors when words are spoken or printed in large fonts.

Documentation

Some individuals with learning disabilities find it difficult to read. Computer documentation provided in electronic forms can be used by enlarged character and voice synthesis devices to make it accessible to those with reading difficulties.

Next Steps

Continue your exploration of adaptive technology by:

- Buying the newspaper or directory and/or attending the conference of Closing the Gap, P.O. Box 68, Henderson, MN 56044; (612) 248-3294.
- Contacting the Tech Act resource center in your state; call RESNA at (702) 524-6686 for information.
- Joining electronic discussion lists and accessing resources on the Internet. A good place to start is the DO-IT home page at http://weber.u.washington.edu/~doit

Additional Information

Primary funding for the DO-IT program is provided by the National Science Foundation. Additional grants have been received from NEC Foundation of America and US WEST Communications. The University of Washington also contributes substantial resources to this project.

For further information, to be placed on the DO-IT mailing list, or to request materials in an alternative format, contact:

DO-IT
University of Washington
4545 15th Ave. NE, Room 206
Seattle, WA 98105–4527
(206) 685-DOIT (Voice/TTY)
FAX: (206) 685-4045
doit@u.washington.edu
http://weber.u.washington.edu/~doit/

University of Washington
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